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Abstract

According to the Bureau of Labor Statistics (2008), science, technology, engineering, and math (STEM) occupations constitute a growing sector of Arizona's economy. However, the number of African Americans earning degrees related to these occupations has not kept pace with this growth. Increasing the participation of African Americans in STEM education fields and subsequent related occupations in Arizona is vital to growing and maintaining the state's economic stature. This objective is made even more compelling given that each year, from 2008–2018, there are 3,671 projected job openings in STEM fields in Arizona. This study explores the extent to which the attitudes held by African Americans in Arizona toward STEM related majors and careers influence their likelihood of joining the state's scientific workforce. Our analyses reveal the importance of career consideration, confidence in one's ability to be successful in a STEM related field, and family support of the pursuit of STEM education and careers.

Keywords: Attitudes, African Americans, Arizona, Science

According to the U.S. Bureau of Labor Statistics, the science, technology, engineering, and math (STEM) workforce in the US will include 8,650,000 jobs by 2018, with a 17% increase in available jobs between 2014 and 2024. However, 84% of working professionals currently in STEM fields are White or Asian males (Lehming, Gawalt, Cohen, & Bell, 2013). African Americans are among the most critically underrepresented groups (Moore, 2006). Broader participation from traditionally underrepresented groups, such as African Americans, in STEM professions is necessary to ensure the vitality of the United States scientific workforce (Charleston & Jackson, 2011; Pearson, 2002). Supplying the United States scientific workforce with employees relies heavily on tactically and purposefully broadening participation in STEM related educational fields (Jackson, Charleston, George, & Gilbert, 2012; Moore, 2006; Pearson, 2002).

Currently, the United States' highest-paying engineering and scientific positions are occupied by White males (Charleston & Jackson, 2011; Moore, 2006). In contrast, African Americans occupy less than three percent of these positions (Moore, 2006). Although steps have been taken to alter the landscape of the scientific workforce (e.g., National Sciences Foundation's (NSF) Broadening Participation in Computing (BPC) program), these patterns of participation are projected to remain relatively static in the 21st century (Moore, 2006). If these trends persist, the United States' scientific workforce will become less stable (American Council on Testing (ACT), 2006; Charleston & Jackson, 2011).

African Americans face multiple obstacles in pursuing STEM-related professions (Charleston & Jackson, 2011). For example, African Americans often have greater educational needs when they reach the collegiate level than their White counterparts, as the K–12 education system often inadequately prepares them for core college courses (Ashby, 2006). Specifically, African Americans are more likely than their White counterparts to progress through the K–12 system without acquiring the necessary knowledge in math and science to succeed at subsequent levels of education (e.g., undergraduate education) and in STEM careers (Charleston & Jackson, 2011).

Additional impediments to African Americans' paths to college include a lack of social capital and status (Ashby, 2006). Social capital is the resources one could aggregate from a durable social network. The amount of social capital one could obtain depends on the quality and quantity of the resources provided by people in this network (Bourdieu, 1986). While many individuals who go into in STEM careers have access to, and significant interactions with, professionals in the field that enable advice and support, African Americans are less privy to these resources (Gottfredson, 2002). Similarly, as it relates to status, many African American students tend to not have the requisite family connections or networking systems to aid them in preparing for, and pursuing STEM-based work fields (Charleston & Jackson, 2011).

The prevalent obstacles encountered during K–12, undergraduate, graduate, and postgraduate years lead to the lack of African American representation in the most senior-level positions within the scientific workforce (ACT, 2006; Ashby, 2006). Therefore, although their participation in STEM fields has increased, African Americans remain consistently underrepresented in STEM in general, and particularly in senior level STEM positions (Ashby, 2006). While there are clearly structural factors that impede African Americans' pursuit of STEM related college majors and careers, such as lack of access to equitable school funding, facilities and high quality teachers (e.g., College Board, 2012), personal and family factors are also implicated in the literature (Charleston & Jackson, 2011).

This research assesses the effects of attitudes toward STEM-related fields on the probability of African Americans pursuing such majors and careers in Arizona. More specifically, it reports results from a study that explored the following two research questions:

1) Do attitudes toward STEM fields among African Americans in the state of Arizona influence their decisions to pursue college degrees and careers in these fields after controlling for other personal characteristics?
2) What are the significant factors that lead to the pursuit of STEM majors and careers in the state of Arizona?

Establishing the Problem

The lack of a viable STEM workforce increasingly poses a threat to the United States' position as a leader in science and technology (Anderson & Kim, 2006). In particular, the nation's declining scientific workforce, specifically among participants of color, will continue to jeopardize the country's ability to solve complex technological challenges. These challenges affect the country's ability to protect its citizens and address their social well-being (Brazziel & Brazziel, 1997; Chubin, May, & Babco, 2005; Maton & Hrabowski, 2004). A landmark report by the National Academies Press (2007) entitled *Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* affirms the importance of this issue:

> We strongly believe that a worldwide strengthening will benefit the world's economy—particularly in the creation of jobs in countries that are far less well off than the United States. But we are worried about the future prosperity of the United

> States. Although many people assume that the United States will always be a world leader in science and technology, this may not continue to be the case in as much as great minds and ideas exist throughout the world. We fear the abruptness with which a lead in science and technology can be lost—and the difficulty of recovering a lead once lost, if indeed it can be gained at all. (p. 60)

This quote highlights the sense of urgency for establishing a viable scientific workforce and importantly, one that is comprised of people from diverse cultural backgrounds. A culturally diverse scientific workforce is essential for the United States to remain a global leader and to reach its full potential in the areas of science and technology.

Former President Barack Obama also highlighted the need for a stronger scientific workforce for America's future:

> [The] key to meeting these challenges—to improving our health and well-being, to harnessing clean energy, to protecting our security, and succeeding in the global economy—will be reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation. (Jones, 2010)

According to the National Academies Press (2007) report, 38 of the world's 50 top research institutions are located in the United States. While the US constitutes approximately four percent of the world's population (U.S. Census Bureau, 2016b), these prestigious institutions have produced more than 20% of the world's doctorate degrees in science and engineering. Unfortunately, despite the relative, if shrinking, number of people earning science and engineering doctorate degrees in the US, the number of African Americans in these fields is less than satisfactory.

The most troubling concern associated with an increased focus on STEM initiatives is the minimal participation of people of color, particularly African Americans, in undergraduate and graduate programs that prepare students for the scientific workforce (Lewis et al., 2011; Moore, Madison-Colmore, & Smith, 2003). According to McSherry (2005), African Americans continue to be one of the least represented cultural groups in these high-demand STEM fields, constituting less than 10% of all students enrolled in STEM undergraduate programs at American institutions. Additionally, African Americans are reported to constitute less than 10% of all graduates from baccalaureate programs from the top 50 institutions (Anderson & Kim, 2006) and constitute three percent of all STEM doctorate recipients (Felder, Parrish, Collier & Blockett, 2016).

Jackson (2010) described this lack of participation in STEM fields as a "quiet crisis." The question is doubly demanding: How might institutions increase the presence of African Americans in the STEM workforce if they have minimal participation in postsecondary programs?

The Case in Arizona: Pipeline to STEM Fields for African American K-12 Students

As Arizona seeks to expand the representation of African Americans in its scientific workforce, it is imperative to understand current projections of African American representation in STEM fields within the state. Based on the latest data, African American K–12 students constitute 5.5% of the 1,087,817 students enrolled in Arizona public schools (NCES, 2009a). Additionally, their academic performance in math and science courses in selected grade levels did not effectively prepare them for the Arizona scientific workforce. Based on these data, Arizona public school students overall: (a) scored lower than 44 states in fourth-grade mathematics achievement, (b) scored lower than 33 states in eighth-grade mathematics, (c) scored lower than 41 states in fourth-grade science, and (d) scored lower than 36 states in eighth-grade science (NCES, 2009a; 2009b; 2009c; 2009d; 2009e).

National databases provide insight of Arizona's outcomes in preparing African Americans for the scientific workforce. Scores in critical math and science courses—which may lead to careers in STEM professions—are primary indicators of this population's future employment prospects in these fields. Data from NCES (2009a) documents show the pipeline connecting African American students in K–12 schools to the Arizona scientific workforce is insufficient at best. In Grades 4–8, more than 70% of African American students in each grade did not reach proficiency in these essential math and science courses. Table 1 provides a snapshot of the performance of African American students at these grade levels. According to the U.S. Department of Education, there are not enough African American students in the "Advanced" science category to equal 1%.

Table 1

African American Student Performance in Selected Content Areas and Grade Levels in Arizona

Content Area	Grade Level	Below Basic	At Basic	At Proficient	At Advanced
Mathematics	4%	41%	40%	16%	3%
Mathematics	8%	42%	35%	18%	5%
Science	4%	48%	39%	14%	-
Science	8%	63%	29%	8%	-

Source: U.S. Department of Education, National Assessment of Educational Progress, 2009

The Bureau of Labor Statistics (2008) has noted that Arizona will continue to be a leader in creating STEM occupations. For the calendar year 2018, projections indicate STEM-based careers will continue to grow. For example, the data indicate that Arizona will have the following number of STEM-related positions, either currently filled or available, by 2018: (a) 67,675 computer and mathematical occupations, (b) 34,972 engineering occupations, and (c) 26,314 life science, physical, science, and other science occupations—all with a projection of 3,671 job openings over this time period. Based on these projections, mean wages for these positions will range, on average, from $27.30–$34.23 per hour through 2018. These numbers demonstrate that Arizona will continue to demand a highly trained workforce from diverse backgrounds. While national recruitment will supply some of these workers, it is critical that Arizona generates a significant talent pool from within its own borders for these occupations. At this time, the potential for African Americans in Arizona to help fill these positions does not look promising.

Although the future of African American participation in STEM occupations remains an area of concern, even more alarming is the relative lack of African American STEM graduates from postsecondary institutions in Arizona. Data in Table 2 reveal that African American graduates at the associate, bachelor's, masters', and doctoral levels are sparse. These data illustrate the small proportion of STEM degrees awarded to African Americans in Arizona in 2008–2009: (a) 385 of 4,861 at the associate level, (b) 207 of 4,994 bachelor's degrees, (c) 13 of 1,159 master's degrees, and (d) five of 443 doctoral degrees. African American degree attainment in these STEM fields will need to increase substantially for this population to participate as viable members of the STEM workforce.

Table 2

Gap between the Number of Projected Annual Job Openings and of Degrees Awarded in STEM Fields in Arizona, 2008–2009

Type of Degree	Degrees Awarded to African Americans	Total Degrees Awarded (2008-2009)
Doctoral Degree	5	443
Master's Degree	13	1,159
Bachelor's Degree	207	4,994
Associates Degree	385	4,861
Projected Annual Job Openings	**3, 671**	

Source: Bureau of Labor Statistics. (2008). *Employment Projections, 2008–2018*. Washington, DC: Author.

The proportion of degrees awarded to African American students in Arizona is low, particularly at the state's three public universities – Arizona State University, University of Arizona, and Northern Arizona University – totaling three percent of all conferred degrees. When comparing Arizona to other states in the Southwest, Arizona's postsecondary enrollment rates are comparable to percentages in Texas. In particular, eight percent of all Arizonian undergraduates are African American women, and Texas' African American women constitute roughly seven percent of all undergraduate students in the state (NCES, 2014c). Furthermore, Arizona and Texas have similar ratios for undergraduates majoring in STEM (i.e., engineering-, biology-, math-, and physical science-related majors) and baccalaureate degrees awarded. According to NCES (2014c) data, African American undergraduate women make up at least 50% of all Black students majoring in STEM fields. Similarly, the proportions of baccalaureate degrees awarded to African American women (7%) in both Texas and Arizona are identical. It is clear that African American women continue to outnumber their male counterparts; however, it is evident that the success rates of African American women continue to trail behind other racial and ethnic groups in STEM-related fields of study (NCES, 2014c).

Despite these similarities, African American students are among the top three racial/ethnic groups to drop out of school (Milem, Salazar, & Bryan, 2016), thus, limiting opportunities for entry into STEM fields. Though Arizona continues to grapple with degree attainment gaps and retention issues for several minority groups, especially African Americans, there seem to be no palpable initiatives or policy changes that address the issues facing these populations. It is projected that Arizona's economic development will be in jeopardy if these issues are not addressed (Morrison Institute for Public Policy, 2016).

In summary, it is critical that researchers and policymakers devote more attention to African American representation in Arizona's scientific workforce and their academic achievement in elementary and secondary school pipelines. Based on current achievement levels, it is imperative that the state of Arizona work to increase exposure to STEM fields and promote these fields as viable career options for African American students early in their academic trajectories. Such awareness and action are essential for the United States to maintain its position as a global leader in the areas of science and mathematics (National Academies Press, 2007). As President Obama asserted, "Emphasizing STEM education—especially to girls and minority students—is one of the most important efforts the US can make if it hopes to produce college and career-ready students" (African American Education Initiative Network [AAEIN], 2011, p. 15). Arizona serves as an example of the challenges and potentials for increasing STEM education and employment throughout the entire United States.

Theoretical Framework

This study's theoretical perspective is informed by self-efficacy theory, which posits that human behavior is influenced by an individual's beliefs regarding outcome and efficacy expectations, as well as past learning experiences (Bandura, 1977). Here, we apply this theoretical framework to discuss African Americans and their academic and career trajectories within STEM-related fields.

Self-Efficacy Theory

Bandura (1977) posited that outcome expectation is derived from an individual's confidence that a particular behavior will produce a specific outcome, and that an efficacy expectation embodies the idea that a task can be successfully performed given a requisite behavior to create the desired outcome. These ideas are the core of self-efficacy theory. Specifically, self-efficacy relies upon self-assessments of one's capabilities. Additionally, outcome expectations derive from internalized beliefs about the consequences of a particular performance, while incentives serve to justify whether or not a behavior will be initiated (Bandura, 1986).

Literature regarding the state of the STEM pipeline emphasizes the important link between self-concept, confidence, and perceived ability in STEM education and occupations (Leslie, McClure, & Oaxaca, 1998; Meece, Parsons, Kaczala, Goff, & Futterman, 1982). Students are more likely to enroll in optional or additional math and science courses if they believe they have high self-confidence in these subjects. In most cases, it is the contribution or input of teachers, parents, mentors, counselors, or peers that shapes a student's self-efficacy and persistence in STEM, although this evidence is more implicit than explicit (Leslie et al., 1998). However, African Americans are often poorly advised and frequently discouraged from pursuing advanced courses within STEM education fields, which contributes to their lack of self-efficacy and lower participation within these disciplines (Moore, 2006).

Self-Efficacy Theory and Occupational Choice

Prior research has applied self-efficacy theory to the process of occupational choice (e.g., Hackett & Betz, 1981; Hackett & Campbell, 1987; Lent & Hackett, 1987) and has established the relevance of performance accomplishments or successes as avenues that lead to increases in self-efficacy. These studies have also demonstrated that ability ratings, interest, and attributions are all influenced by performance (Hackett & Campbell, 1987). This body of research posits that self-efficacy beliefs predict significant indices to career-entry behavior (i.e., college choice and academic performance) within particular fields (Lent & Hackett, 1987). This research also shows that self-efficacy ratings among college students decrease upon failing tasks, further illuminating the relationship between performance accomplishment and self-efficacy (Hackett & Campbell, 1987). Ultimately, perceived efficacy and mechanisms that foster self-evaluation facilitate the growth of intrinsic interests, enabling individuals to persist in activities that promote feelings of satisfaction and efficacy (Bandura, 1986). As such, these interests serve to explain participants' self-efficacy and their subsequent likelihoods of thriving and persisting in STEM fields throughout their educational and occupational careers.

These earlier studies were instrumental in relating self-efficacy and career trajectories. Lent, Brown, and Larkin (1984) reported that while vocational interests alone were not significant predictors of persistence in career fields, self-efficacy and interest both contribute to unique variance in occupational considerations. The researchers found that technical and scientific self-efficacy is predictive of both grades in technical courses and the range of considered career options, as well as persistence in technical majors. Additionally, Post-Kammer and Smith (1986) found that interest and self-efficacy are strong predictors of math and non-math-related occupational considerations among economically disadvantaged women, and that interest alone was a strong predictor of the aforementioned occupational considerations among economically disadvantaged men.

Recent studies have addressed the psychological and social forces underlying the differences between male and female self-efficacy in STEM (Newcombe et al., 2009). The literature has also provided evidence of gender differences for self-efficacy or personal efficacy for a variety of STEM-related occupations among high school students (Eccles, 1994). Longitudinal studies demonstrated that females were less confident than males in their own outlook for success in the areas of science-related professions and in male-dominated skilled labor occupations (Eccles, 1994). However, compared to females, males demonstrated less confidence in their success in health-related professions and other occupations perceived as gendered (i.e., nursing, speech or occupational therapy, pediatrician, etc.). The differences in occupational efficacy presented within these and similar studies were also determined to be significant predictors of occupational choice (Eccles, 1993; Eccles, 1994; Eccles & Wigfeild, 2002; Messersmith, Garrett, Davis-Kean, Malanchuk, & Eccles, 2008).

Many African Americans are not as privy to critical supports such as access to individuals currently succeeding in STEM fields that build a sense of self-efficacy in STEM-based career trajectories. Still, there are African Americans who have succeeded within these fields, apparently having achieved the necessary self-efficacy to be confident contributors to STEM-related occupations. Based on our review of the literature, self-efficacy assumptions are an important part of the theoretical framework applied to this study.

In concert with other studies (e.g., Hackett & Betz, 1981; Hackett & Campbell, 1987; Lent & Hackett, 1987) that have applied self-efficacy theory toward efforts to understand the process of occupational choice, this study sought to determine the relevance of pertinent attributes or influences on self-efficacy gains for STEM educational choices and related careers among African American participants. This study ultimately strives to identify connections between attitudes toward educational and occupational decision-making, and STEM education and career choices among African Americans in Arizona. Unlocking the components that enable self-efficacy among study participants will better elucidate the attitudes and decision-making processes of African Americans who go into STEM careers in the state. Given its role in career development, self-efficacy theory provides a means to explain the alignment between attitudes, confidence, and the decision to select STEM as an educational and occupational path.

Methodology

To understand attitudinal differences among African Americans towards STEM-related majors and careers, we utilized logistic regression analysis with data from a state-wide survey of African Americans in Arizona. The dataset, variables, and analysis procedures are described in the next section.

Dataset

Participants in this study completed the State of Black Arizona STEM Attitudes Survey (SBASAS), a state-wide investigation into the extent to which Arizona African Americans' attitudes toward STEM-based majors and careers influenced their choice to join the scientific workforce. A broad-based sampling was used to collect these survey data between June and July, 2011. Data were collected at 24 churches, 2 community events and meetings, and 5 community listservs in Phoenix, Flagstaff, and Tucson. This broad-based sampling effort was utilized to capture participants in various community settings. In total, the research included 634 survey responses. Among those who completed the survey, 61.7% were females and 38.3% were males. The average age of individuals in the sample was 48 years. Concerning parental status, 73.8% had at least one child. Lastly, 27.1% of the individuals had majored in a STEM field.

Data Analysis

We performed a logistic regression to understand the differences in attitudes toward STEM related majors and careers among African American. This analysis was used to assess the effects of attitudes toward STEM on the probability of an individual pursing a STEM major and STEM career (Cabrera, 1994). Several measures of fit were used to determine the significance of each logistic regression model: chi-square of the model, pseudo R^2, and percentage of correct predictions (PCPs). A significant chi-square indicates that the independent variable as a group correlates with the dependent variable. At most, the pseudo R^2 represents the proportion of error variance in relation to a null model. PCPs represent the percent of cases predicted by the model. PCPs higher than 55% signify a good fit for the model (Cabrera, 1994). As a measure of the magnitude of effect, delta-p was used, a representation of the change in dependent variable probability due to a change in the factor variable under consideration. For example, a delta-p value of 0.045 indicates that a one-unit change in the predictor is related to a 4.5 percentage point increase in the likelihood that a faculty member would become an academic leader. These measures were examined in relation to our dependent and independent variables.

The dependent variable for STEM majors was based on responses to this SBASAS question: "Did you pursue a STEM major in college?" Responses were recoded to create a binary indicator variable for majoring in STEM. The dependent variable for the STEM careers was based on individuals' responses to the SBASAS question: "Are you working in a STEM field?" Responses were similarly recoded to create one binary indicator variable for working in STEM. Additionally, independent variables were selected based on research on African American's aspirations to pursue STEM degrees and occupations. While we considered published research to select variables for the present model (Charleston & Jackson, 2011; Hackett, 1985; Lent et al., 1984; Maton & Hrabowski, 2004), we limited our focus since the research is not yet clear on the particular factors that promote or impede STEM aspirations. Our primary hypothesis is that attitudes toward STEM affect degree and career aspirations after controlling for background characteristics. Accordingly, the logistic regression models included 17 independent variables. The background measures (see appendix A) included: (a) gender, (b) age, and (c) parental status. The 14 measured attitudes included: (a) considered, (b) society, (c) interesting, (d) difficult, (e) ability, (f) assistance, (g) job opportunities, (h) high pay, (i) respected, (j) self-development, (k) community, (l) family support, (m) welcomed, and (n) successful. These variables are reflective of current literature and are the most ideal for a study of this kind.

Findings

This study examined the extent to which attitudes held by African Americans in the state of Arizona toward STEM-based majors and careers influenced their representation in the state's scientific workforce. Table 5 shows the results of two separate logistic regression models, which were specified to consider decisions to pursue STEM degrees and careers respectively. Each model reports the delta-p values for statistically significant variables. The columns display statistically significant delta-p values, which illustrate the change in default probability[1] that each significant variable makes, controlling for all others. Based on the goodness-of-fit indices, both the STEM major and STEM career models are excellent fits. In the STEM major model, the delta-p values indicate that three variables significantly affected the probability of the observed representation of individuals who pursued STEM majors. None of the background characteristic variables were significant. With regard to attitude variables, default probability was increased if the individual considering a STEM major felt that they had the ability to complete a STEM degree, and believed that their family supported their STEM degree pursuit. Although not significant, the following variables produced negative effects: society, interesting, assistance, high pay, respected, community, and successful (see Appendix B).

In the STEM career model, the delta-p values indicate that there were five variables that significantly affected the probability that the observed individuals pursued STEM careers. As for background characteristics, female status and age both increased default probability. For attitude variables, default probability was increased if the individual considering selecting a STEM major felt that he/she had the ability to complete a STEM degree, and believed that his/her family supported the STEM degree pursuit. These variables, while not significant, had negative effects: society, assistance, job opportunities, respected, community, welcomed, and successful (see Appendix C).

Table 5

Logistic Regression Results for the Decision to Pursue STEM Degrees and Careers

Variable	**STEM Major**	**STEM Career**
Background Characteristics		
Gender (female)		0.1014*
Age		0.0058***
Parent		
Attitude Variables		
Considered	0.1997***	0.1680***
Society		
Interesting		
Difficult		
Ability	0.0886*	0.0807*
Assistance		
Job Opportunities		
High Pay		
Respected		
Self-Development		
Community		
Successful		
Welcomed		
Family Support	0.1193***	0.0958**
Sample	684	684
P_o	0.2714	0.2367
Model X^2, df	213.633, 17***	191.513, 17***
Pseudo R^2	0.419	0.392
PCP	0.813	0.821

Note. Delta-p statistics are shown only for those variables whose coefficients were significant: *p< .05, **p<.01, ***p<.001

Discussion

The results from this study show that some STEM-related attitudes have a minimal effect on whether or not African Americans in Arizona pursue STEM majors and careers. Statistically significant results emerged for each of the models, yet the magnitude of these variables was small overall. Nonetheless, at least six conclusions based upon the analyses and guiding framework can be drawn from this study.

First, with regard to the background variables, there are at least two plausible reasons that gender (female) showed a positive relationship with pursuing a STEM-based career. There is current and emerging evidence that there has been an increase in the enrollment of African American females in particular STEM majors. For example, from 2004 to 2014, there was a 138% increase in all African American women majoring in STEM within Arizona. However, in comparison to the larger population of STEM majors, African American women continue to be underrepresented – constituting 1.2% of all 2004 STEM majors and 3.3% of all women majoring in STEM, and totaling 1.5% of all STEM majors and 3.8% of all women majoring within the fields in 2014. When the data are disaggregated by degree-level (i.e., undergraduate and graduate students), the increases for African American women across the decade are marginal in comparison to White women (NCES, 2014b).

National data provides further insight into the increase in STEM degree attainment. In 2007, women earned half or more of all bachelor's degrees awarded in biology (60%), agriculture (50%), and chemistry (50%) (National Science Board, 2010). In fact, since 2002, women have earned an astounding 58% of all bachelor's degrees, and about half of all science and engineering bachelor's degrees since 2000 (National Science Board, 2010). African American women continue to lag in fields such as math and engineering; however, they produce more biology and health profession-related baccalaureate degrees out of all STEM fields reported (NCES, 2014a). Therefore, the participation rates of African American women in STEM careers may reflect the effect of such underlying increases overall. Additionally, the gender distribution of the sample, which was 61.7% female, likely played a role in this finding.

Second, age showed a positive relationship with pursuing a STEM career. It is likely that those more stable in their career choices are older. It is also reasonable to suspect that age possibly approximates experience. This result seems to support the conventional notion that there is no substitute for work experience with regard to understanding career choices and desires.

Third, the variable “considered”—a measure of whether the individual entertained selecting a major in STEM—showed a positive relationship with pursuing STEM majors and careers. This finding suggests that individuals must be exposed to opportunities that present STEM majors and careers as viable options. For example, previous research (e.g., Charleston & Jackson, 2011; Maton, Hrabowski, & Schmitt, 2000; Moore et al., 2003) has documented that a social network of family and friends who have majored and worked in STEM-fields may play a significant role in shaping career desires and aspirations. Likewise, there is ample research (e.g., Leslie et al., 1998; Pearson, 2002) demonstrating how participation in STEM-based intervention programs is crucial for diversifying the ranks of undergraduate and graduate programs, and consequently, the scientific workforce.

Fourth, the variable ability—a measure of individuals’ belief that they have the ability to obtain a degree in a STEM field, if they choose to do so—revealed a positive relationship with both pursing STEM majors and careers. Thus, confidence in one’s ability to do well in a degree program or career plays a role in decision-making. This finding also points to self-efficacy as a prerequisite for considering STEM educational and occupational goals. For example, a study on women in engineering found that those who begin college as engineering majors are less likely to complete their respective programs because of a lack of "professional role confidence" (Cech, Rubineau, Silbey, & Seron, 2011). More explicitly, students demonstrated low self-efficacy in the content and practical areas of an engineering career. In turn, the results suggest that women continually believed they were not fit for an engineering career, doubting that they would eventually become professional engineers.

Fifth, the variable family support showed a positive relationship with pursing STEM majors and careers. Family support remains a critical aspect of college and degree selection for African American students (Maton & Hrabowski, 2004; Moore, 2006), because moving into academic fields viewed as "new" is difficult without a strong support system.

Lastly, a number of not significant dynamics emerged about the sample population. Namely, those in the survey population: (a) did not believe that society valued the contributions of STEM, (b) did not find STEM subjects to be interesting, (c) did not find faculty and peer assistance readily available, (d) did not perceive STEM jobs to be high paying, (e) did not think society respected individuals who work in STEM fields, (f) did not view STEM as a diverse major or career field, (g) did not think that African Americans could have successful careers through STEM, (h) did not find there to be more job opportunities in STEM, and (i) did not feel they were welcome in STEM majors or careers.

The results of the study demonstrate that STEM-related attitudes do affect the likelihood that African Americans in Arizona will pursue STEM majors and careers. The findings highlight factors that are useful in shaping degree and career aspirations for those in the sample. In particular, study results demonstrate the importance of career consideration, how confidence in one's own ability to be successful in a STEM-based field matters, and the importance of family support for the pursuit of a STEM education and career. Simultaneously, the negative coefficients show areas where opportunities exist to smooth the pathways for African Americans to STEM majors and careers. That is, they demonstrate that, among African Americans in Arizona, STEM fields must be demystified as they relate to the following areas: (a) societal views of STEM professionals, (b) the earning potential of STEM professionals, (c) the versatility within STEM-related fields, (d) the potential for lucrative and successful careers in STEM, and (e) available job and career opportunities in STEM. Furthermore, these negative coefficients identify potential systemic challenges within the educational pipeline (i.e., the extent to which African Americans do not feel that support from faculty or peers is available, do not feel that African Americans are welcomed in STEM, and do not think African Americans can have successful careers in STEM) that prevent equal access to knowledge and experiences that promote and encourage careers in STEM-based fields.

Limitations

There are several limitations of this study. First, the analyses were limited to variables collected by the survey. While these data are a rich source of information about attitudes of African Americans in Arizona toward STEM, information about background characteristics was limited. Second, it is unclear how representative these data are because there was no way to compare participants' attitudes with those of individuals who did not participate. Likewise, because other studies have not focused on the state of Arizona concerning attitudes toward

STEM majors and fields, there is no pre-existing research from which to draw insights. Fourth, relying on participants to recall their attitudes while they were students presents a limitation for this study since entry into the workforce is yet to be determined. Finally, although the results are specific to the state of Arizona, they may have implications for states with similar characteristics and demographics.

Implications for Self-Efficacy Theory and STEM

In prior studies with self-efficacy as a theoretical framework, researchers presented evidence of the impact of teachers, parents, mentors, counselors, and/or peers on a student's self-efficacy and persistence in STEM (Leslie et al., 1998). This study further supports these assertions with emphasis on several specific factors. Variables founded to increase individuals' likelihood of pursuing a STEM degree or career among study participants included: considering a STEM major, self-confidence to complete a STEM degree, and level of family support to pursue a STEM degree. Additionally, confidence, as demonstrated by the participants in this study, proved to be partially a result of their families' support, as prior research on self-efficacy has indicated. Moreover, educational and occupational choice is highly influenced by an individual's belief that they can complete a given task, which is reflective of participants' expectations that they had the ability to complete a STEM degree. Therefore, these factors producing STEM educational and occupational choices are directly related to self-efficacy theory.

While it may appear that the "successful" variable could be included as an attribute of self-efficacy, this study treated it as the external perception that African Americans can have successful careers in STEM-based fields without explicit connection to one's own career trajectory. Ultimately, the variables that constituted self-confidence, efficacy assessments, and expectations that a specific task could be successfully performed (i.e., the aforementioned correlating attitude variables) were accounted for within the default variables (i.e., the decision to pursue STEM degrees or STEM careers). Therefore, the study results corroborate that self-efficacy in STEM has the propensity to increase positive attitudes as it relates to STEM education and occupations, thus increasing the likelihood of participation in the scientific workforce among African Americans at large.

Recommendations for Future Research

Based on the findings of this study, the authors provide the following recommendations for future areas of research:

1. Conduct focus groups with African Americans in STEM fields in the state of Arizona to inform the body of literature on attitudes and perceptions among this demographic group.
2. Design and disseminate for analysis a survey to college recruiters in Arizona to understand the most effective recruitment strategies that are used to entice African Americans to pursue STEM fields at colleges and universities.
3. Examine articulation agreements between Arizona community colleges and universities to recruit African Americans to STEM majors in colleges/universities.
4. Design empirical studies that examine how Arizona compares with "peer" states on the inclusion of African Americans in STEM. Based on the findings, a specific set of recommendations should be provided to a variety of constituents.

5. Survey STEM employers in the state of Arizona to inform various constituents on the specific recruitment and retention strategies that have been successful at increasing and retaining their African American STEM workforce.

These recommendations provide a path forward for the state of Arizona to increase the number of African Americans that participate in the STEM workforce. Further, these recommendations can strengthen recruitment efforts for African Americans to pursue STEM fields in colleges and universities within the state. These factors will build a stronger pool of diverse STEM candidates to strengthen state and national economies. In order for this initiative to be successful, community colleges within the state must be key stakeholders as they are the most diverse (in terms of student demographics) institutions of higher education and fertile ground for the recruitment of African American students for STEM fields. As a result of the aforementioned recommendations, Arizona will be positioned to increase the representation of African Americans in its STEM workforce.

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Appendix A

Variable Codes and Descriptions

Code	Descriptions
Gender	Gender of participants [Male Referent Group]
Age	Age of participants [Continuous]
Parent	Parental status [No is Referent Group]
Considered	Considered selecting a major in STEM
Society	I think STEM is very important in our society
Interesting	I think STEM topics/subjects are interesting
Difficult	I think topics/subjects in STEM fields are difficult
Ability	I believe I would have the ability to get a degree in a STEM field if I chose to major in STEM
Assistance	I think I could easily get assistance from faculty and peer students if I chose a STEM major in college
Job Opportunities	I think that majoring in STEM fields is associated with more job opportunities
High Pay	I believe jobs in STEM fields are associated with high pay
Respected	I think people working in STEM fields are respected in our society
Self-Development	I think I can get more opportunities for self-development/growth in STEM fields
Community	I think there are a lot of people majoring/working in STEM fields in my community
Family Support	I believe that my family highly supports or once supported me to get a degree in a STEM field
Welcomed	I believe that African Americans are welcomed in STEM-based careers
Successful	I believe that African Americans can have successful careers in STEM-based fields

Appendix B

Logistic Regression Output for the Decision to Pursue STEM Degrees

	B	S.E.	Wald	df	Sig.	Exp(B)
Gender (female)	.086	.224	.148	1	.700	1.090
Age	.011	.009	1.773	1	.183	1.011
Parent	.172	.266	.421	1	.517	1.188
Considered	.872	.119	53.881	1	.000	2.392
Society	-.009	.253	.001	1	.973	.991
Interesting	-.011	.241	.002	1	.963	.989
Difficult	.162	.116	1.947	1	.163	1.176
Ability	.412	.167	6.112	1	.013	1.510
Assistance	-.106	.145	.530	1	.467	.900
Job Opportunities	.061	.193	.100	1	.752	1.063
High Pay	-.192	.208	.855	1	.355	.825
Respected	-.160	.170	.891	1	.345	.852
Self-Development	.157	.162	.943	1	.332	1.170
Community	-.015	.115	.018	1	.893	.985
Family Support	.543	.155	12.339	1	.000	1.721
Welcomed	.017	.133	.016	1	.899	1.017
Successful	-.245	.175	1.962	1	.161	.783

Appendix C

Logistic Regression Output for the Decision to Pursue STEM Careers

	B	S.E.	Wald	df	Sig.	Exp(B)
Gender (female)	.499	.227	4.826	1	.028	1.647
Age	.032	.009	12.393	1	.000	1.032
Parent	.019	.277	.004	1	.947	1.019
Considered	.785	.120	42.756	1	.000	2.193
Society	-.144	.251	.331	1	.565	.866
Interesting	.111	.249	.200	1	.655	1.118
Difficult	.202	.118	2.911	1	.088	1.224
Ability	.405	.171	5.586	1	.018	1.499
Assistance	-.039	.146	.071	1	.790	.962
Job Opportunities	-.028	.200	.019	1	.891	.973
High Pay	.212	.212	.999	1	.318	1.236
Respected	-.135	.172	.614	1	.433	.874
Self-Development	.141	.162	.762	1	.383	1.152
Community	-.130	.116	1.262	1	.261	.878
Family Support	.474	.157	9.070	1	.003	1.606
Welcomed	-.194	.132	2.164	1	.141	.824
Successful	-.037	.181	.042	1	.837	.963

[1] In the context of this study, the default probabilities are decisions to pursue STEM degrees and majors for each model represented by their respective dependent variables.